Apprenticeship and Industry Training

Powerline Technician

Apprenticeship Course Outline

2104.4 (2004)

Government of Alberta

Apprenticeship and Industry Training

Powerline Technician
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Course Outline

Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of Powerline Technician Provincial Apprenticeship Committee.

The graduate of the Powerline Technician apprenticeship program is a certified journeyperson who will be able to:

- responsibly do all work tasks expected of a journeyperson
- supervise, train and coach apprentices
- use and maintain hand and power tools to the standards of competency and safety required in the trade
- construct, maintain, operate or repair electrical distribution systems and their equipment
- practice the safe work practices required by the trade
- perform with dexterity the hand skills required to carry out the required mechanical work
- perform assigned tasks in accordance with quality and production standards required by industry

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The board also provides advice to the Minister of Advanced Education and Technology on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the board can set up a local apprenticeship committee. The board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the board

Provincial Apprenticeship Committees (PAC)

The board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- Make recommendations to the board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the board

Powerline Technician PAC Members at the Time of Publication

Mr. P. Ryan	Edmonton	Presiding Officer
Mr. P. Archer	Calgary	Employer
Mr. R. Phillips	Calgary	Employer
Mr. R. Chychul	Claresholm	Employer
Mr. J. Magill	Edmonton	Employee
Mr. R. Friesen	Edmonton	Employee
Mr. J. Avgoustis	Fort McMurray	Employee
Mr. B. Taylor	Leduc	Employee

Alberta Government

Alberta Advanced Education and Technology works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the board, industry committees and Alberta Advanced Education and Technology to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act.***

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.gov.ab.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Addendum

As immediate implementation of the board's safety policy includes common safety learning outcomes and objectives for all course outlines, this trade's PAC will be inserting these safety outcomes into the main body of their course outline at a later date. In the meantime the addendum below immediately places the safety outcomes and their objectives into this course outline thereby enabling technical training providers to deliver the content of these safety outcomes.

STANDARD WORKPLACE SAFETY

A. Safety Legislation, Regulations & Industry Policy in the Trades .....

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting .....

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection.....

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.

The following institutions deliver Powerline Technician apprenticeship technical training:

Northern Alberta Institute of Technology
Fortis Alberta
ATCO Electric

Procedures for Recommending Revisions to the Course Outline

Advanced Education and Technology has prepared this course outline in partnership with the Powerline Technician Provincial Apprenticeship Committee.

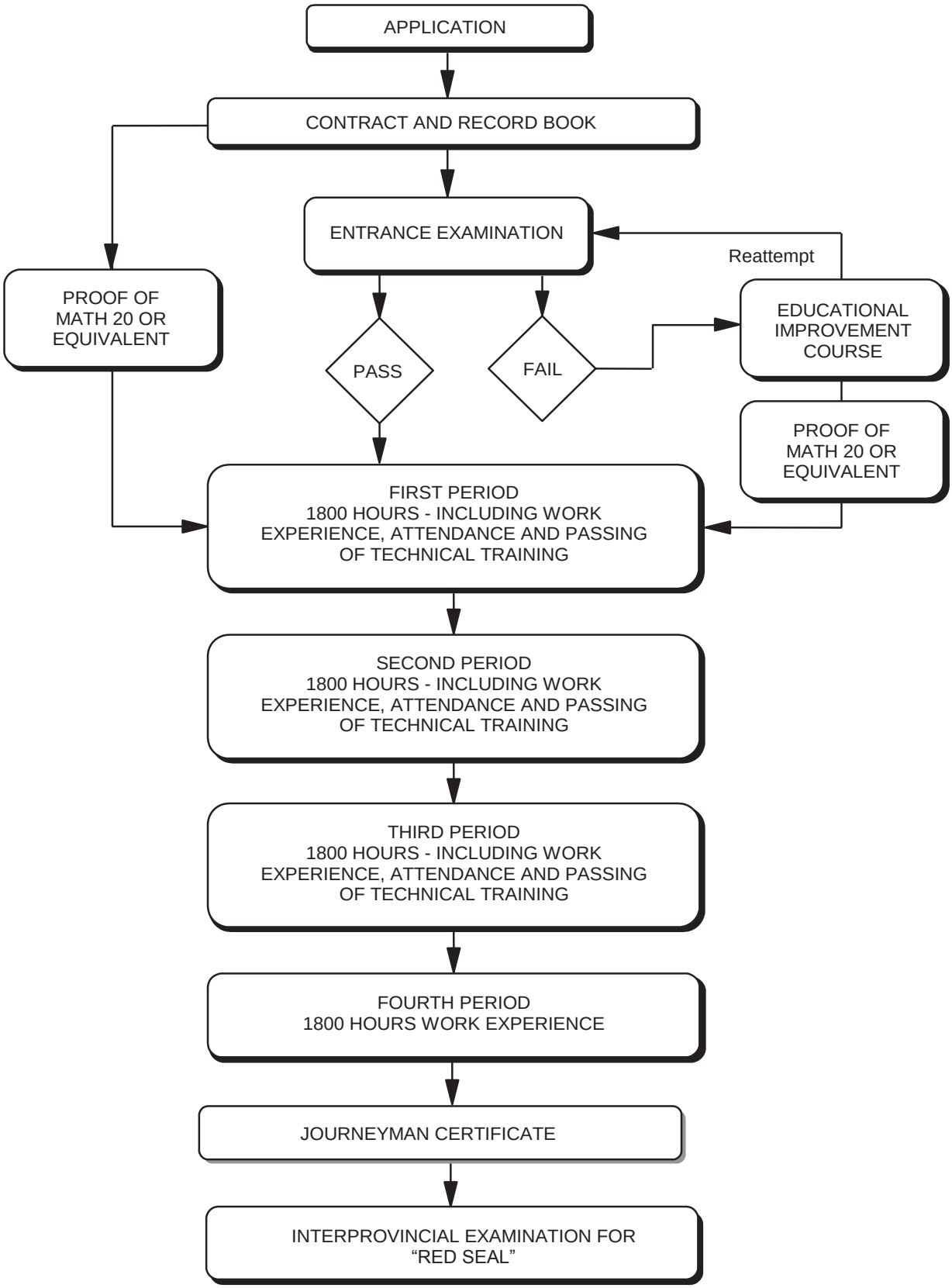
This course outline was approved on September 30, 2004 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

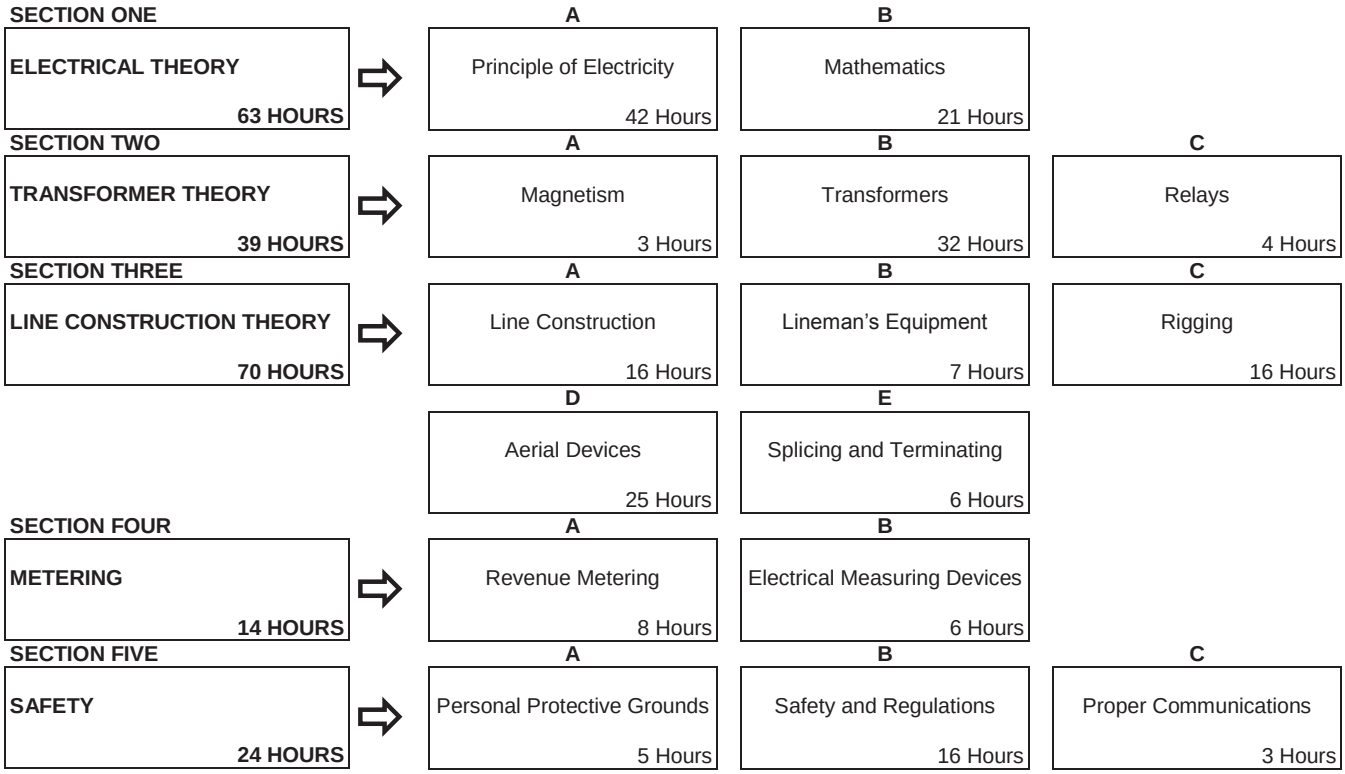
Powerline Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education and Technology
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Powerline Technician Provincial Apprenticeship Committee.

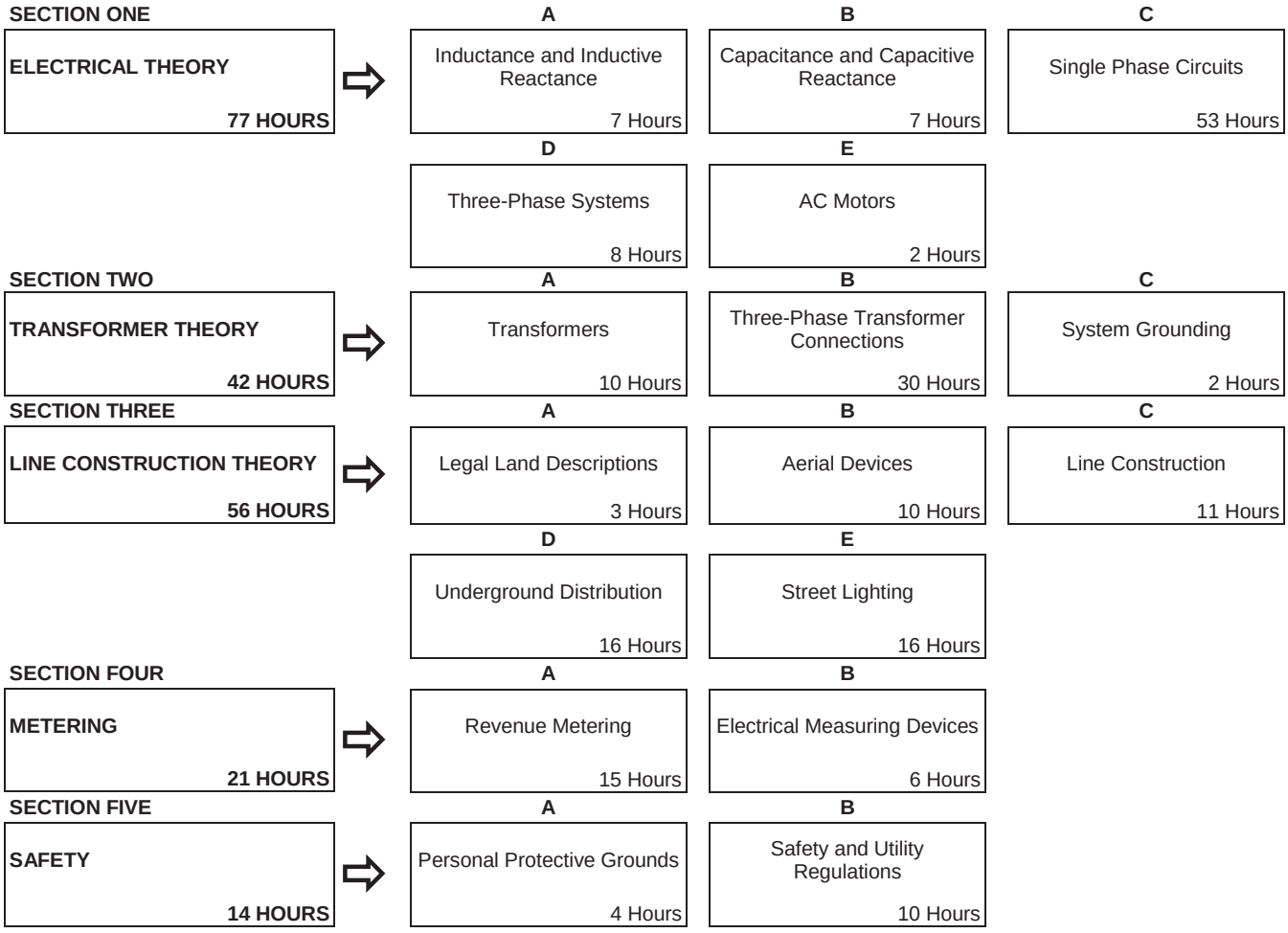
Apprenticeship Route toward Certification



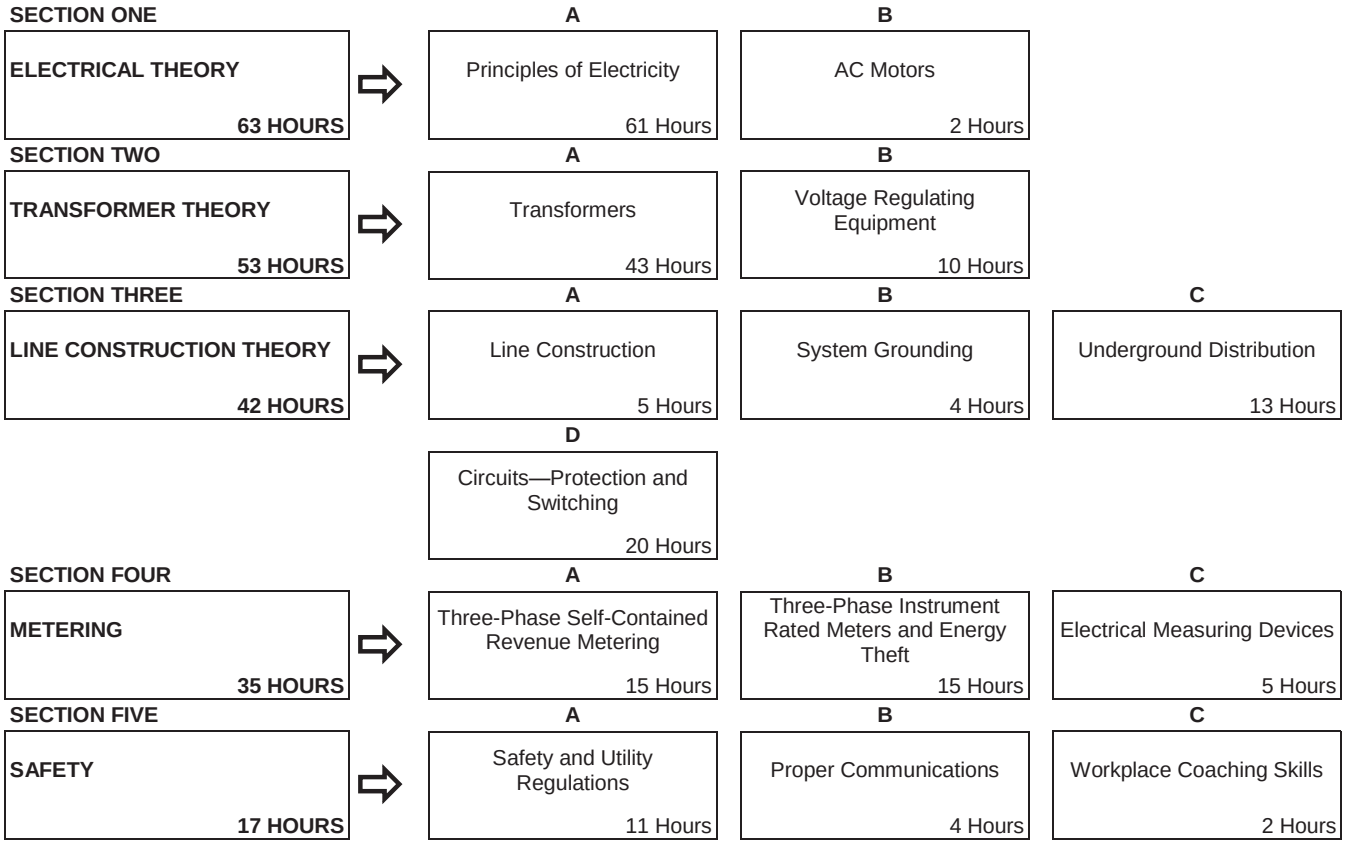
Powerline Technician Training Profile
FIRST PERIOD
(7 Weeks 30 Hours per Week – Total of 210 Hours)



SECOND PERIOD
(7 Weeks 30 Hours per Week – Total of 210 Hours)



THIRD PERIOD
(7 Weeks 30 Hours per Week – Total of 210 Hours)



NOTE: The hours stated are for guidance and should be adhered to as closely as possible. However, adjustments must be made for rate of apprentice learning, statutory holidays, registration and examinations for the training establishment and Apprenticeship and Industry Training.

FIRST PERIOD TECHNICAL TRAINING
POWERLINE TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Powerline Technician, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.
Special emphasis should be placed on weak areas of theory and lab that are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and testing shall be allowed for in each area of instruction.

SECTION ONE: .....ELECTRICAL THEORY ..... 63 HOURS

A. Principles of Electricity .....42 Hours

Outcome: Explain and demonstrate knowledge of basic AC and DC fundamentals.

1. Explain the fundamental relationship between the structure of the atom and the flow of electrons.
2. List the methods used to generate AC and DC emf.
3. Describe the relationship between cycles, poles and frequency.
4. Define, give symbols, and state units of measurement for the following electrical terms:
   a) volts
   b) amperes
   c) ohms
   d) watts
   e) watthours
   f) coulombs
   g) joules
5. State Ohm's law and explain its application to electrical circuits, using calculations.
6. Measure a circuit for voltage current and resistance.
7. Analyze and explain series, parallel and three wire AC and DC electrical circuits, and identify their applications.
8. Apply Kirchhoff's current and voltage laws to circuits.
9. Solve problems involving series, parallel and three wire circuits (balanced and unbalanced).
10. Describe the effect that an open neutral will have on a customer's load (balanced and unbalanced) (neutral disconnected).
11. Define and describe line loss and voltage drop as it applies to electrical power systems.
12. State the effects that an increase in load current has on the voltage at the load.
13. Solve applicable problems involving line loss and voltage drop.
14. State nominal voltages used on utility systems.
15. Connect and take measurements of series and parallel circuits using schematic and wiring diagrams to verify Ohm's law.
16. Connect batteries for series and parallel operation.

17. Describe alternating current values of sine waves.
18. Define instantaneous value.
19. Define RMS or effective value.
20. Define maximum or peak value.
21. Illustrate in phasor analysis direction and magnitude of phasors:
    a) direction and magnitude
    b) phasor relationship
    c) phasor addition
22. Define:
    a) vector
    b) phasor
    c) lead
    d) lag
    e) cycle
    f) angles in electrical degrees
23. Estimate the resultant of a phasor addition and be able to add phasors:
    a) direction and magnitude
    b) phasor relationship
    c) phasor addition

B. Mathematics .....21 Hours

Outcome: ***Explain and demonstrate the use of applicable math principles for solving electrical problems.***

1. Transpose simple algebraic equations to solve with one unknown.
2. Solve problems involving percentages.
3. Solve problems involving ratio and proportions.
4. Solve right angle triangles using trigonometric functions given two unknowns.
5. Solve problems involving magnitude and direction vectors.
6. Solve linear, area, volume, weight and temperature problems using SI metric units.
7. Convert between SI metric units and Imperial units.

SECTION TWO: ..... TRANSFORMER THEORY ..... 39 HOURS

A. Magnetism .....3 Hours

Outcome: ***Explain the laws of magnetism.***

1. Describe the basic characteristics of magnetic lines of force.
2. Outline the relationship between current and magnetism to explain transformer action.

B. Transformers .....32 Hours

Outcome: ***Explain the theory and operation of a transformer.***

1. Describe the basic components of a distribution transformer and the nameplate information.
2. List the purposes of a transformer.
3. Identify primary and secondary of a transformer.

4. Differentiate between a step-up and a step-down transformer.
5. Explain the standard terminal and winding identification.
6. Describe AC transformer action.
7. Explain the forces that exist between current carrying conductors on utility systems.
8. Describe the operation of a transformer as load is added.
9. List the losses that occur in a transformer.
10. State why utilities accept 100% efficiency for transformer calculations.
11. State how transformers are rated and typical manufactured (kVA) sizes of distribution transformers.
12. Describe and solve problems involving transformer voltage, turns and current ratios.
13. Explain the reason why transformers are rated in voltage and volt-amps.
14. Describe the possible effects of operating a transformer at above its rated voltage.
15. Differentiate between the high voltage and the low voltage windings of a transformer with the use of an ohmmeter.
16. Calculate the rated primary and secondary currents of a transformer from nameplate data.
17. Select a properly rated transformer for a specified load.
18. Differentiate between subtractive and additive external polarity.
19. Connect the internal windings of a transformer for series or parallel operation (include a 4 bushing secondary transformer).
20. Describe the various methods of cooling for distribution transformers and the liquids used.
21. Describe the hazards of PCB's as related to transformers.
22. Describe how to set a tap changer to increase and decrease secondary voltage levels.
23. Recall the approximate voltage change that will result when the tap is changed by one step.
24. Describe the steps required to safely change the tap changer on a transformer.
25. Explain why a tap changer is required.
26. Connect a single and double bushing transformer including all grounding according to ECUC.
27. List the items to be checked prior to installing a transformer.
28. Select the size of fuse from a fuse chart for a given transformer.
29. Describe the connection of a lightning arrestor according to ECUC.
30. Define the causes of backfeed, hazards involved and how to avoid it.
31. Explain the grounding of a single–phase secondary service and explain the hazards of improper grounding on the customer's service.
32. Describe how to take an oil sample and how it is tested.
33. Explain how impurities in oil affect its dielectric strength.

C. Relays.....4 Hours

Outcome: ***Explain the purpose and operation of a relay.***

1. Purpose and operation.
2. Connect a simple relay to demonstrate basic relay operation.
3. Connect a relay to demonstrate a simple street light circuit using an electric eye as a switch.

SECTION THREE: .....LINE CONSTRUCTION THEORY.....70 HOURS

A. Line Construction .....16 Hours

Outcome: Explain and describe various requirements of line construction.

1. Describe the types of materials and application of typical poles, used as power line structures.
2. Define the differences between classes of wood poles.
3. Explain/describe purpose and information found on pole stamp.
4. Describe loading, hauling and unloading of poles.
5. Describe basic framing for cross arms and attachments of wood poles.
6. Describe typical erection of poles.
7. Describe the forces exerted on power line structures.
8. List the hazards involved in power digging and how to minimize these hazards.
9. Identify the standardized markings that are used in Alberta to mark location of underground facilities.
10. List methods used to safely set poles.
11. Determine when pole cover up and rubber gloves are required to be used when setting poles.
12. Describe the factors that affect how poles are faced in various situations.
13. Describe problems caused when poles are improperly backfilled and tamped.
14. Explain the hazards involved in:
    a) safety checks to be made prior to climbing a pole
    b) climbing stub poles
    c) signs
    d) butt condition
    e) surface rot
    f) belting in above arms
    g) grabbing hardware
    h) pole steps
    i) ice
    j) changing the strain
    k) pole leaning
15. Explain the difference between guyed and self-supporting towers.
16. State the advantages and disadvantages of copper, aluminum and steel line conductors.
17. Recognize conductor sizes with the use of AWG (circular mills).
18. Explain the relationship between the size and ampacity of conductors.
19. List the commonly used types of insulator materials used on power systems.
20. Identify and describe pin type, suspension type, post type and bushing insulators.
21. Define B.I.L. (basic impulse level) rating of power system insulators.
22. Define flashover and leakage current.
23. Define dielectric strength of insulating materials.
24. Describe the different mechanical characteristics of pin, post, suspension and bushing insulators.
25. Identify and describe typical failure causes of power system insulators.

26. List common causes and methods of prevention of radio/TV interference.

B. Lineman's Equipment.....7 Hours

Outcome: ***Explain and demonstrate the inspection, care and maintenance of PPE and hand tools.***

1. Describe the selection, use and operation of wood bits, framing chisels, grips, conductor jacks, bolt and wire cutters.
2. List the inspection and maintenance procedures for lineman's climbing belts and pole straps as per OH&S Code (part 9).
3. Demonstrate sharpening of climber gaffs.
4. Describe care, maintenance and safety precautions for power hand drills and grinders:
   a) air
   b) hydraulic
   c) electric
5. Describe the proper care, maintenance and storage of protective rubber gloves, sleeves, live line tools and live line cover-up.
6. Illustrate the daily inspection of protective rubber gloves, sleeves, live line tools and live line cover-up.
7. Describe the visual and di-electric testing of protective rubber gloves, sleeves, live line tools and live line cover-up.
8. List the applications of commonly used hot sticks and accessories.

C. Rigging.....16 Hours

Outcome: ***Explain and demonstrate competency in safe rigging practices.***

1. Describe the effect that sling angles have on safe lifting.
2. Identify the load limits of commonly used wire rope slings and synthetic slings.
3. Describe the causes and effects of shock loading on rigging.
4. Identify OH&S Code (part 21) regarding rigging safety factors.
5. Explain the reasons for proper reeving and demonstrate how to reeve set of multiple rope blocks.
6. Identify the mechanical advantage of a single and of a multiple sheave rigging configuration.
7. Explain/identify results of improper reeving.
8. Describe the proper care and use of wire rope.
9. Identify rating of wire rope given rope specifications table.
10. Describe the proper care and use of synthetic rope.
11. Identify rating of synthetic rope given rope specifications table.
12. Demonstrate a typical application of a half hitch, bowline, sheet bend, timber hitch, rolling pipe hitch, round turn, two half hitches and load binder hitch.
13. Make an eye splice in a braided rope.

D. Aerial Devices .....25 Hours

Outcome: Describe and understand crane and hoisting principles.

1. Demonstrate knowledge of crane and hoisting signals.
2. Explain the importance of crew communications when operating aerial devices (buddy system).
3. Maintain an equipment logbook as per owner's instructions and in accordance with the OH&S Code (part 6).
4. Explain improper practices and how they damage aerial devices.
5. Explain how to position and stabilize an aerial device for safe and efficient operation of:
   a) level ground
   b) sloping ground
   c) overhead obstacles
6. Identify and describe how cranes can be overloaded by:
   a) lifting loads in excess of their gross capacity
   b) booming down and increasing load radius
   c) telescoping out and increasing load radius
7. Describe the correct way to raise or lower the load, boom and swing the load including points such as:
   a) the proper deployment of outriggers including the types of outrigger pads and blocking
   b) leveling of the boom truck and the effects of not being level
   c) two-blocking
   d) not allowing personnel to ride on loads and hooks
   e) using man baskets
   f) no impact
   g) no overloading
   h) no excessive side loading
   i) no free fall
   j) no swing-out
   k) allowance made for wind
8. Explain that releasing the load should be done without impact.
9. Explain why cranes are not designed to drag loads.
10. Assess the following characteristics of a boom truck:
    a) configuration of boom truck (on outriggers)
    b) quadrant of operation
    c) boom length
    d) boom angle
    e) load radius
11. Describe the components and purpose of load charts.
12. Describe forward and backward stability factors used in the formulation of load charts.
13. Describe structural strength and design factors used in the formulation of load charts.
14. Describe the effect of quadrants of operation on capacity.
15. Recognize whether the boom truck's capacity is limited by structural strength factors or tipping factors.
16. Define gross capacity, gross (rated) load and net capacity.

17. Specify the calculations necessary for determining the net capacity of a boom truck when jibs and boom extensions are not installed.

18. Perform the following calculations:

    a) deductions of any extra weight of line and rigging components not included in the capacity charts
    b) percentage of load to rated capacity

19. Determine net capacity of hydraulic boom cranes with:

    a) boom fully extended; pinned section retracted
    b) boom partially extended; pinned section retracted
    c) boom fully extended; pinned section extended
    d) boom partially extended; pinned section extended

20. Determine net capacity when figures fall between chart values in:

    a) radius
    b) boom angle
    c) boom length

21. Specify the calculations necessary to determine the net capacity of a boom truck with jibs or boom extensions installed and lifting from jib or boom extension either full or partially extended.

22. Identify the weight of loads using available means:

    a) use of load weighing and moment devices
    b) estimating weights using accepted industry formulae
    c) sources of weight information, e.g. bills of lading, drawings

E. Splicing and Terminating .....6 Hours

Outcome: Demonstrate the principles of splices, connections and terminations.

1. Describe the proper care and use of mechanical presses.
2. Describe the proper use of a manual hydraulic and power driven hydraulic press.
3. Describe how to check for proper compression.
4. Describe the preparation of ACSR, AAC, and solid copper conductor for splicing and dead-ending.
5. Select and use the proper conductor splicing sleeves and press dies using reference charts (include automatic type splices).
6. Select and use the proper insulated sleeve for low voltage conductor splicing from reference charts.
7. Demonstrate manufacturer's operating and maintenance practices for explosive assisted tools.

SECTION FOUR: ..... METERING .....14 HOURS

A. Revenue Metering .....8 Hours

Outcome: Explain the basic principles of single phase self contained revenue metering.

1. Read a single–phase meter (energy and demand).
2. Verify socket connections and make necessary checks on the meter prior to changing or installing a new meter:
   a) single–phase two wire A base
   b) single–phase two wire S base
   c) single–phase three wire A base
   d) single–phase three wire S base
   e) check for a creeping meter
3. Explain what a clock-over and a complete clock-over are.

B. Electrical Measuring Devices .....6 Hours

Outcome: Explain and demonstrate the use of electrical measuring devices.

1. Describe the proper care and safety precaution for ohmmeters, ammeters, voltmeters and meggers.
2. Demonstrate accurate measurements using a voltmeter, ohmmeter, ammeter and megger.
3. Demonstrate proper scale range selection, wiring connections for portable ohmmeters, voltmeters, ammeters and meggers.

SECTION FIVE:.....SAFETY.....24 HOURS

A. Personal Protective Grounds .....5 Hours

Outcome: Describe and explain personal protective grounding.

1. List the hazards that personal protective grounds guard against.
2. List the electrical and mechanical requirements of a personal protective ground.
3. Outline the procedure for installing and removing personal protective grounds as defined in the ECUC.
4. Explain the required locations of personal protective grounds according to ECUC.

B. Safety and Regulations .....16 Hours

Outcome: Locate and identify rules and regulations according to legislated requirements.

1. Describe an overview of the employer and employee responsibilities under the OH&S Act, Regulations and Code.
2. Describe an overview of the employer and employee responsibilities under the Noise (Part 16) and First Aid (Part 11) of the OH&S Code.
3. Explain/describe employer and employee responsibility regarding WHIMS.
4. Define the basic principle of Workers' Compensation.
5. Complete sample reporting forms for a hypothetical on the job injury.
6. State the terms of apprenticeship for an apprentice Powerline Technician entering the Powerline Technician trade.

7. Describe the advancement criteria of an apprentice entering the trade.
8. Describe/explain the role and purpose of the advisory network and Provincial Apprenticeship Committee for the Powerline Technician trade.
9. Locate and use section “0” to interpret Objectives, Scope ad Definitions of the Electrical and Communication Utility Code (ECUC).
10. Locate and use section “2” to interpret General Rules of ECUC.
11. Locate and use section “4” of the ECUC to interpret safety rules applicable to work on electrical utility lines.
12. State the (Part 17 of the OH&S Code and Part 4 of the ECUC):
    a) safe limit of approach distances from overhead power lines for persons and equipment
    b) limit of approach distances for utility employees
    c) limit of approach distances for qualified utility employees
    d) limit of approach distances for qualified utility employees performing live line work using rubber gloves
    e) limit of approach distances for qualified utility employees performing live line work using bare hand techniques
    f) limit of approach distances for qualified utility tree trimmers, tree workers and other workers
13. Identify applicable ECUC Rules given a typical work situation.
14. Describe the effects of current through the human body.
15. Recall accident history of typical electrical utility accidents and be able to describe in your own words the causing factors and propose corrective methods to prevent recurrences of similar accidents.
16. Describe in point form the methods used by your utility for rescue from:
    a) a pole
    b) an aerial device
    c) platform
17. Explain/describe the purpose of the apprentice record book for:
    a) apprentice’s role
    b) employer’s role
    c) competency task check-off requirements
    d) updating procedures

C. Proper Communications .....3 Hours

Outcome: Describe and demonstrate effective communication skills.

1. Explain, describe and conduct a tailboard and safe work plan as described in OH&S Code (Part 2) given a typical construction job plan including hazard assessment.
2. Complete the electric utilities accident occurrence report form given the details of a public related electric accident.
3. Demonstrate proper signing on and signing off procedures for mobile radios.
4. Identify unacceptable radio use.

SECOND PERIOD TECHNICAL TRAINING
POWERLINE TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Powerline Technician, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.
Special emphasis should be placed on weak areas of theory and lab that are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and testing shall be allowed for in each area of instruction.

SECTION ONE:.....ELECTRICAL THEORY ..... 77 HOURS

A. Inductance and Inductive Reactance (as Related to Transformers).....7 Hours

Outcome: ***Describe and apply the concepts of inductance and inductive reactance as it applies to AC circuits and utility systems.***

1. Describe inductance and the factors which affect inductance.
2. Describe induction and its effect on the circuit.
3. Define mutual induction as related to a transformer.
4. List the factors that affect the amount of emf induced into a conductor.
5. Illustrate the direction of an induced emf.
6. State the symbol for inductance.
7. State the unit of measurement for inductance and its symbol.
8. Identify and draw the circuit symbols representing coils.
9. Describe how induction voltage limits current.
10. Describe the danger of voltage being induced into conducting objects from a nearby energized AC power line.
11. Define inductive reactance.
12. Give the symbol for inductive reactance and state its unit of measurement.
13. Explain the equation for inductive reactance.
14. Describe the purpose and application of reactors in utility systems.
15. State the phase relationship between voltage and current in an inductive circuit.

B. Capacitance and Capacitive Reactance.....7 Hours

Outcome: ***Describe and apply the concepts of capacitors as it applies to AC circuits and utility systems and analyze an AC capacitive circuit.***

1. Describe the construction of an elementary capacitor.
2. Describe capacitance and the factors that affect it in underground cable and overhead lines.
3. Describe the hazards of stored energy in transformers and underground cable.
4. Interpret the nameplate rating of a power capacitor.
5. Explain the resultant rating of a capacitor bank when capacitors are connected in series or parallel with each other.

6. Define dielectric strength.
7. Define capacitance.
8. State the unit measurement for capacitance.
9. Define capacitive reactance.
10. Give the symbol for capacitive reactance and state its unit of measurement.
11. Explain the equation for capacitive reactance.
12. State the phase relationship between voltage and current in a capacitive circuit.
13. Explain the purpose and application of capacitors used in utility systems.
14. Explain the ECUC requirements for switching and grounding of capacitors.
15. Explain the environmental hazards of PCB's used in capacitors.
16. Explain the hazards of re-fusing capacitors.

C. Single–Phase Circuits.....53 Hours

Outcome: ***Describe series and parallel RLC circuits, true power, apparent power, reactive power and power factor correction as it applies to AC circuits.***

1. Define impedance.
2. State the units of measure for impedance.
3. Restate formulas required to calculate impedance.
4. Outline factors that affect impedance.
5. Use the "impedance triangle" to solve electrical problems.
6. Explain the phase relationship of a series RL circuit by the use of a phasor diagram.
7. Explain the phase relationship of a series RC circuit by the use of a phasor diagram.
8. Explain the phase relationship of a series RLC circuit by the use of a phasor diagram.
9. Identify the hazards of a series RLC circuit and verify by circuit connection and measurement.
10. Explain the phase relationship of a parallel RL circuit by the use of a phasor diagram and verify by circuit connection and measurement.
11. Explain the phase relationship of a parallel RC circuit by the use of a phasor diagram and verify by circuit connection and measurement.
12. Explain the phase relationship of a parallel RLC circuit by the use of a phasor diagram and verify by circuit connection and measurement.
13. Define “true power” and give its Sl symbol.
14. State the unit of measurement for “true power” and give its abbreviation.
15. Define "apparent power" and give its Sl symbol.
16. State the unit of measurement for "apparent power" and give its abbreviation.
17. Define "reactive power" and give its Sl symbol.
18. State the unit of measurement for "reactive power" and give its abbreviation.
19. Define "power factor".
20. Define "power factor angle" and give its symbol.
21. State the relationship between "power factor" and "power factor angle".
22. State why it is desirable to operate electrical systems at a high power factor.
23. Identify the devices that can be used for power factor correction.

24. Perform power factor correction calculations and verify by connections and measurements.
25. Explain why 0.9 (90%) is an acceptable power factor.

D. Three–Phase Systems ..... 8 Hours

Outcome: Describe the fundamental characteristics of wye and delta three-phase systems.

1. State the advantages for three–phase systems over single–phase systems.
2. Name the two types of three–phase connections.
3. Define the term: BALANCED three–phase system.
4. State the phase relationship for the 3 voltages in a three–phase system.
5. State and verify by connection the relationship between phase and line for a wye system:
   a) current
   b) voltage (stress voltage relationships)
6. State and verify by connection the relationship between phase and line for a delta system:
   a) current
   b) voltage (stress voltage relationships)

E. AC Motors..... 2 Hours

Outcome: Explain operating characteristics of single-phase motors.

1. Recall that interchanging the supply leads cannot reverse a single–phase motor.
2. Relate the possible effects of over voltage and under voltage on a motor.
3. Explain how single–phase motor load affects cold pick up.

SECTION TWO: ..... TRANSFORMER THEORY ..... 42 HOURS

A. Transformers..... 10 Hours

Outcome: Explain the theory, operation, connections and parallel operation of single-phase transformers.

1. State how transformers are rated and typical manufactured (kVA) sizes of distribution and kVA transformers.
2. Review and solve problems involving transformer voltage, turns and current ratios.
3. Explain why transformers are rated in voltage and volt-amps.
4. Review the rated primary and secondary currents of a transformer from nameplate data.
5. Review subtractive and additive external polarity.
6. Review the function and operation of transformer tap changers.
7. Define % IZ.
8. Explain the purpose of % IZ stated on the nameplate.
9. Determine the maximum fault current from nameplate data.
10. List the conditions to be met before operating two transformers in parallel.
11. Connect two transformers in parallel and check how they share the load.

12. Explain the differences in application of transformers in the following situations:
    a) network
    b) power - substation
    c) distribution

B. Three-Phase Transformer Connections ..... 30 Hours

Outcome: Explain the theory, operation and connections of three-phase transformers.

1. Determine the expected secondary voltage by the use of a phasor diagram.
2. List the possible connections and changes that are to be made before hanging transformers in a bank.
3. Decide, given the nameplate information, the supply voltage and required load voltage, the connection required.
4. Draw a connection diagram for the above.
5. Connect and use proper fusing for the transformer banks (single and double bushing transformers).
    a) delta–delta
    b) wye–wye
    c) delta–wye
    d) open delta–open delta
    e) open wye–open delta
    f) delta–four wire delta
6. Determine the percentage of customer loading and load allowed for open wye or open delta connections.
7. Measure the secondary voltages.
8. Describe hazardous backfeeds from transformers.

C. System Grounding ..... 2 Hours

Outcome: Describe system grounding.

1. Describe the function of a ground rod as an electrical connection.
2. Describe the hazards of an open neutral or a ground conductor.

SECTION THREE: ..... LINE CONSTRUCTION THEORY ..... 56 HOURS

A. Legal Land Descriptions ..... 3 Hours

Outcome: Explain the use of legal land descriptions.

1. Locate a given legal land description on a map.
2. State the legal land description of a location identified on a map.

B. Aerial Devices ..... 10 Hours

Outcome: Explain basic hydraulic principles.

1. Explain the basic principle of hydraulics:
    a) transfer of energy
    b) mechanical advantage

2. Describe the operation of a hydraulic cylinder:
   a) single acting
   b) double acting
3. Describe the operation of a hydraulic pump as used on an aerial device.
4. Describe the operation of a hydraulic motor.
5. Identify all parts of a hydraulic system given a basic schematic for an aerial device.
6. State the functions of the following components on an aerial device given a basic schematic:
   a) control valve
   b) relief valve
   c) holding valve
   d) hydraulic fluid reservoir
   e) screens and filters
   f) pressure gauges
   g) breathers
7. Trace the hydraulic flow through a system given a basic schematic.
8. Perform a pre-use daily inspection of an aerial device to include the following items:
   a) booms
   b) main frame
   c) turret
   d) load line
   e) auger
   f) controls
   g) pump and PTO
   h) hydraulic oil level
   i) holding valves
9. Identify the above deck points requiring lubrication on an aerial device.
10. State problems and solutions involved with basic cold weather start-up of hydraulic systems.

C. Line Construction ..... 11 Hours

Outcome: Describe the applications of various types of anchors and stringing methods.

1. Describe typical kinds and the holding capacity of power line anchors.
2. Describe the proper installation of typical anchor types.
3. Describe the proper placement of anchors and common reasons for anchor failure.
4. Calculate guy tensions.
5. Describe common methods of handling and storage of reels of conductor.
6. Describe common methods of stringing and recovering power line conductors.
7. Describe the relationship between tension and sag for secondary service leads.
8. Define the conductor loading conditions as identified in ECUC.

D. Underground Distribution.....16 Hours

Outcome: ***Identify and explain the function and the installation of the various components and equipment in primary and secondary underground systems.***

1. Compare a typical overhead and underground system using the following factors:
   a) cost
   b) appearance
   c) ease of troubleshooting
   d) ease of operation
   e) reliability
2. Identify the commonly used primary and secondary cables.
3. Identify and explain the function of the various components of primary and secondary underground cables.
4. Splice and terminate primary and secondary cable up to 25 KV rating (plastic only):
   a) modular
   b) tape
   c) cold shrinks
5. Install heat and cold shrinks without damaging the insulation.
6. Identify and explain the functions of the components of a termination (including potheads).
7. Identify associated equipment such as pad mount transformers, switching cubicles, secondary termination points and distinguish between live front and dead front equipment.
8. Connect underground cable to associated equipment.
9. Explain the proper OH&S Code (part 32) procedures to be followed when trenching or excavating.
10. Compare direct burial and ductwork for underground cable using the following points:
    a) where each is used
    b) installation methods
    c) repair methods
    d) increasing system capacity
    e) ECUC requirements
11. Install and interpret operation of fault indicators.
12. Identify a load break and a non-load break elbow.
13. Verify proper system operation after commissioning.
14. Explain the terms loop, radial and network system.

E. Street Lighting .....16 Hours

Outcome: ***Explain, identify, connect and maintain various street lighting systems.***

1. Identify visually and by operating characteristics mercury vapour, HP sodium, LP sodium and metal halide.
2. List the two purposes of a ballast.
3. Explain what happens in a hot restart.
4. Describe the operation of a photoelectric eye, normally open and normally closed:
   a) relay type
   b) bi-metal type

5. Describe the operation of a street light relay.
6. Describe the hazard of a broken outer bulb.
7. Describe the proper disposal methods of bulbs:
   a) ultraviolet
   b) sodium
8. Explain the causes of improper light distribution as affected by mounting height, levelling and correct refractor.
9. Connect from a print the following types of lighting systems:
   a) self contained eye and ballast
   b) photoelectric eye system
   c) hot day pilot system
   d) hot night pilot system
   e) cascade
10. Identify and change the operating voltage of the ballast.
11. Describe how to locate a fault using a series bulb.
12. Describe how to trace and troubleshoot a system from a print.
13. Explain the purpose of a constant current transformer.
14. Describe the hazards involved in series lighting.

SECTION FOUR: .....METERING ..... 21 HOURS

A. Revenue Metering.....15 Hours

Outcome: ***Explain the operation and connections of single-phase instrument type revenue metering.***

1. Explain the operation of a single–phase meter and the function of each part.
2. Calculate the load on a meter using kh for balanced and unbalanced loads.
3. Calculate the approximate load on a meter using current and voltage for balanced and unbalanced loads.
4. Make proper connections to measure the energy on a single–phase three wire circuit using:
   a) a three wire current transformer
   b) two cross connected current transformers
   c) a doughnut type current transformer
5. List the purposes of instrument transformers.
6. Explain the different principles between CTs and PTs:
   a) ratings
   b) connections
   c) hazards
   d) ammeter
   e) voltmeter
7. Determine when the primary of a potential transformer is to be fused according to ECUC.
8. Determine when the secondary of instrument transformer is to be grounded according to ECUC.
9. Explain why a shorting device must be provided on the secondary of a current transformer.
10. Give examples of commonly used ratings of instrument transformers.

11. Connect instrument transformers into a circuit to determine the voltage and the current.

B. Electrical Measuring Devices ..... 6 Hours

Outcome: Explain and demonstrate the correct use of electrical measuring devices.

1. Determine the load and set maxi-meter on proper ratio.
2. Install, read, reset and remove a maxi-meter.
3. Calibrate a recording voltmeter.
4. Install and remove a recording voltmeter.
5. Interpret the chart from a recording voltmeter.
6. Explain the reason for the test circuit on a potential indicating device.
7. Use a potential indicating device to test for presence of a voltage, safely and accurately.
8. Test for presence of a potential by buzzing according to the rules of ECUC.

SECTION FIVE: ..... SAFETY ..... 14 HOURS

A. Personal Protective Grounds ..... 4 Hours

Outcome: Describe the fundamentals of personal protective grounding for overhead and underground systems.

1. Describe the principle of equi-potential bonding.
2. Describe how to test for potential and install personal protective grounds on underground cables.
3. Describe the factors that affect the resistance of the grounding electrode.
4. Explain the reasons for not placing the ground electrode close to the bottom of the pole.
5. Describe the terms touch and step potential and explain how they can occur.
6. Explain how available fault current varies with proximity to large supply stations, generating plants and motor loads.

B. Safety and Utility Regulations ..... 10 Hours

Outcome: Locate and identify rules and regulations according to legislated requirements.

1. Locate and use section “6” of ECUC to interpret the grounding of utility equipment.
2. Locate and use section “12” of ECUC as it pertains to underground construction (Part 5 and 32 of the OH&S Code).
3. Restate the Safe Limit of Approach distances for personnel and equipment working near lines.
4. Locate and use section “10”, table 2 of ECUC to interpret minimum vertical design clearances above ground.
5. List ways in which an isolated line may become energized.
6. Identify applicable ECUC rules given a typical work situation.
7. Recall accident history of typical electrical utility accidents and be able to describe in your own words the causing factors and propose corrective methods to prevent recurrences of similar accidents.

THIRD PERIOD TECHNICAL TRAINING
POWERLINE TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

Due to the nature of the work of the Powerline Technician, it is imperative that safety be taught on a continuous basis throughout the entirety of this course.
Special emphasis should be placed on weak areas of theory and lab that are evident from progressive tests and examinations administered throughout the course. The time required for such examinations and testing shall be allowed for in each area of instruction.

SECTION ONE:.....ELECTRICAL THEORY ..... 63 HOURS

A. Principles Of Electricity .....61 Hours

Outcome: ***Explain and demonstrate knowledge of AC fundamentals in a three-phase system including power relationships and power factor correction.***

1. State and verify by connection the relationship between phase and line for a wye system:
   a) current (stress current relationship)
   b) voltage
2. State and verify by connection the relationship between phase and line for a delta system (balanced):
   a) current (stress current relationship)
   b) voltage
3. Explain by the use of a phasor diagram the relationship between phase voltage and line voltage in a wye-connected source.
4. Explain the phase relationship of phase currents with phase voltages in a wye-connected system at unity, and other than unity power factor (balanced or unbalanced) by the use of a phasor diagram.
5. Explain the importance of a neutral conductor on an unbalanced wye system.
6. Explain by the use of a phasor diagram the relationship between phase voltage and line voltage in a delta-connected source.
7. Explain the phase relationship of phase currents with phase voltages in a delta-connected system at unity and other than unity (balanced or unbalanced) by the use of a phasor diagram.
8. State the mathematical equation for "apparent power" in balanced systems.
9. State the mathematical equations for "true power" in balanced and unbalanced systems.
10. State the mathematical equations for "reactive power" in balanced and unbalanced systems.
11. Define overall "power factor" as it applies to three–phase systems.
12. Explain how capacitors will correct the power factor in three–phase systems.
13. Recall how capacitors are connected to a three–phase system.

B. AC Motors.....2 Hours

Outcome: Explain operating characteristics of three-phase motors.

1. State the effects that interchanging two line conductors has on the direction of rotation of three–phase motors.
2. List the effects of an open phase on a three–phase motor under starting and running conditions.
3. List the effects of over voltage and under voltage on a three–phase motor.
4. Identify the effects that starting a large three–phase motor has on the utility system.

SECTION TWO: ..... TRANSFORMER THEORY ..... 53 HOURS

A. Transformers.....43 Hours

Outcome: Explain the theory, operation and connections of three-phase transformers.

1. List the uses and advantages of Complete Self Protected (CSP) transformers.
2. Explain how CSP transformers differ from standard distribution transformers.
3. Determine the fusing to be used from a fuse chart.
4. Define the causes of backfeed, hazards involved and how to avoid it.
5. Determine the rated phase and line currents of a three–phase bank.
6. Define angular displacement.
7. Determine if and how three–phase banks can be paralleled.
8. Do alterations on a three–phase bank maintaining the same phase sequence and position of high leg (if applicable) as prior to any work being done.
9. Demonstrate the proper switching sequence to eliminate the possibility of ferro-resonance.
10. Demonstrate how to reduce the effects of ferro-resonance if the construction is such that the switching sequence is not possible.
11. Connect a three–phase transformer bank as per given voltage specifications and demonstrate the effect on a three–phase motor connected to the secondaries if:
    a) interchanging any two primary lines
    b) interchanging any two secondary lines
12. Connect a three–phase transformer bank using the proper connections and fusing for (current and power):
    a) delta–delta
    b) wye–wye
    c) wye–delta
    d) delta–wye
    e) open delta–open delta
    f) open wye–open delta
    g) delta–four wire delta
    h) crowfoot

B. Voltage Regulating Equipment ..... 10 Hours

Outcome: Identify and explain the operation of voltage regulating equipment.

1. Explain the term voltage regulation.
2. State the reasons a utility company requires voltage regulating equipment.
3. Differentiate between off-load and on-load tap changing equipment, and state at least one utility application for each.
4. Interpret the nameplate data on voltage regulating equipment.
5. Explain the effect of the buck or boost winding on the output voltage with the use of a schematic.
6. Describe, in general terms, the operation of a step regulator control unit, making reference to:
   a) basic voltage setting
   b) band width setting
   c) delay timer
   d) buck boost selector switch
7. Describe, in detail, how to switch out a piece of voltage regulating equipment and return it to service.
8. Explain the precaution necessary when paralleling lines or feeders fed from different voltage regulators.
9. Explain the undesirable effects on the customer voltage if the regulator source and load connections are interchanged.
10. Explain how touch potential may exist near voltage regulator controls.
11. Explain how hazards of touch potential may be reduced at voltage regulating equipment.
12. Describe typical pre-commissioning checks on voltage regulating equipment.

SECTION THREE: ..... LINE CONSTRUCTION THEORY ..... 42 HOURS

A. Line Construction ..... 5 Hours

Outcome: Explain the requirements and methods of sagging for overhead conductors.

1. Explain the effects on a line if the sagging is either too tight or too loose.
2. Choose the appropriate sag chart, given the necessary line and conductor information (initial or final).
3. Determine the correct sag from charts given the necessary line and conductor information.
4. Explain in detail the line and sight method of sagging.
5. Explain in general terms other methods of sagging.
6. Explain methods of determining sag on an existing energized line.
7. Explain the effect on sag of doubling or tripling span length.

B. System Grounding ..... 4 Hours

Outcome: Explain the difference between an earth grounding system and neutral return system.

1. Determine ground resistance by means of a megger or an earth tester.
2. Compare a neutral return system to an earth return system (ECUC).

C. Underground Distribution.....13 Hours

Outcome: ***Explain the requirements for the testing, identification, mapping and switching of new underground installations.***

1. Verify the single line diagram (S.L.D.) as built, identify cables and return construction guarantee of isolation (GOI) (clearance or permit).
2. Explain the hazards of high potential cable testing.
3. Prepare a switching program to energize a new section of an underground system given a single line diagram.

D. Circuits - Protection and Switching.....20 Hours

Outcome: ***Identify and explain operation of circuit protection and switching equipment.***

1. Define the terms fault and fault current.
2. Explain how kVA and % IZ affect fault current.
3. Explain the purpose and basic operation of:
   a) fuses
   b) sectionalizers
   c) oil circuit reclosers
   d) arrestors
   e) relays operating an oil circuit breaker
4. Explain how the time of operation varies with the magnitude of current.
5. Explain what it means to co-ordinate fuses, sectionalizers and oil circuit reclosers.
6. Explain the basic operation and hazards of the following when used for switching:
   a) hot line jumpers
   b) fused disconnects
   c) solid blade disconnects and gang operated switches
   d) sectionalizers and oil circuit reclosers
7. Identify EEMAC (NEMA) device numbers from single line drawings.

SECTION FOUR: .....METERING ..... 35 HOURS

A. Three-Phase Self-Contained Revenue Meters.....15 Hours

Outcome: ***Explain the operation, connections and how to calculate loads of three-phase self-contained revenue meters.***

1. Verify socket connections and make necessary checks on the meter prior to changing or installing a new meter:
   a) three–phase four wire wye “S” base demand energy meter
   b) three–phase four wire delta “S” base demand energy meter
   c) network meter “S” base
2. Explain the effect on the registered consumption of the tickler wire that was not connected.
3. Explain the factors affecting the operation of a demand meter.
4. Calculate the load on a meter using kh for balanced and unbalanced loads.
5. Calculate the approximate load on a meter using current and voltage for balanced and unbalanced loads.
6. Calculate the actual consumption using the internal multiplier and the meter readings.

7. Explain under what conditions a meter must be installed on the load side of a customer's breaker and explain the exception to the rule.
8. Explain where and why a network meter is used.
9. Explain the proper mounting height for self contained meters.
10. Identify the correct phase colour codes and the correct phasing for a three–phase four wire wye and a three–phase four wire delta.
11. Identify a service with a high leg using a voltmeter.
12. Explain what should be done if a new high demand is established.
13. Verify socket connections and make necessary checks on the meter prior to changing or installing a new meter:
    a) three–phase four wire wye "S" base
    b) three–phase four wire delta "S" base
    c) network meter "S" base

B. Three–Phase Instrument Rated Meters and Energy Theft ..... 15 Hours

Outcome: ***Explain the operation, connections and calculate loads of three-phase instrument rated meters and explain government requirements on re-testing of meters for energy diversion/theft.***

1. Wire an instrument rated metering unit.
2. Check the connection of an instrument rated metering unit in reference to a wiring diagram.
3. Install or change a meter on an instrument rated metering unit.
4. Calculate the load on a meter using kh for balanced and unbalanced loads.
5. Calculate the approximate load on a meter using current and voltage for balanced and unbalanced loads.
6. Calculate the actual consumption using the meter readings and the overall multiplier.
7. Explain how the distance between the current transformers and the meter can affect the accuracy of the C.T. (burden).
8. Describe indications of external tampering on metering devices.
9. Describe other indications of energy theft.
10. Explain why the rate structure may vary between customers.
11. Obtain a rate structure from your utility and calculate a domestic and an industrial bill.
12. Explain what a phase converter is and where it might be used.
13. Explain the difference between the government and the utility sealing on meters.
14. Explain the government requirements on re-testing of meters.

C. Electrical Measuring Devices ..... 5 Hours

Outcome: ***Explain and demonstrate the correct use of electrical measuring devices.***

1. Determine the phase sequence of a colour coded or otherwise identified three–phase system with the use of a phase sequence indicator.
2. Relate the hazards involved when using phasing sticks.
3. Demonstrate how to verify proper operation of phasing sticks by cross phasing.
4. Phase-in two three–phase lines with the use of phasing sticks.
5. Interpret the chart to determine the number of resistors to be used on a given voltage.

6. List the reasons for insulation testing.
7. Explain the hazards involved when insulation testing.
8. Explain the term high potential testing.

SECTION FIVE: ..... SAFETY ..... 17 HOURS

A. Safety and Utility Regulations.....11 Hours

Outcome: Locate and identify rules and regulations according to legislated requirements.

1. Locate and use section “10” of the ECUC as it pertains to the operation and construction of overhead systems.
2. Locate and use section “8” of the ECUC as it pertains to the operation of:
   a) generating stations
   b) substations
   c) electrical equipment installations
3. Restate the safe limits of approach distance for personnel or equipment working near lines.
4. Identify applicable ECUC given a typical work situation.
5. Recall accident history of typical electrical utility accidents and be able to describe in your own words the causing factors and propose corrective methods to prevent recurrences of similar accidents.

B. Proper Communications.....4 Hours

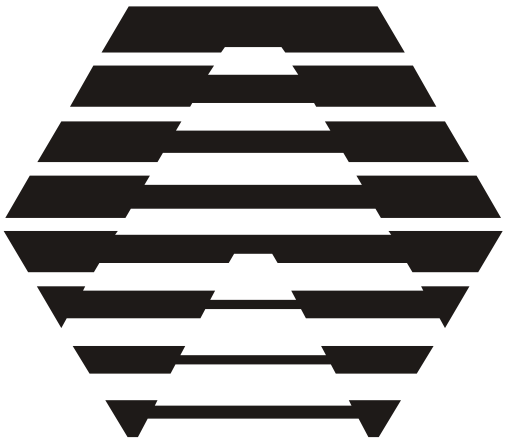
Outcome: Prepare switching programs for overhead and underground systems.

1. From a single line diagram, prepare a switching program to isolate and issue a GOI (or permit) on a section of:
   a) overhead system
   b) underground system
   c) combination of both overhead and underground systems

C. Workplace Coaching Skills.....2 Hours

Outcome: Describe coaching skills for training apprentices.

1. Describe the following coaching skills used for training apprentices:
   a) identify the point of the lesson
   b) link the lesson
   c) demonstrate a skill
   d) provide opportunity to practice a skill
   e) give feedback to the learner
   f) assess the learner’s progress



Excellence through training and experience

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